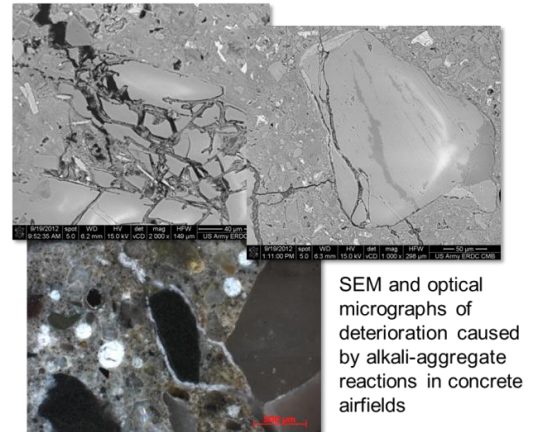




# Forensic Investigations of Infrastructure Deterioration and Failure

## Problem

Civil works infrastructure is subject to multiple forms of deterioration and forensic analysis is often necessary to identify what type of deterioration is occurring or why a material or component has failed in service. Deterioration of concrete can occur by freeze/thaw action, sulfate attack, corrosion, alkali-aggregate reactions, physical abrasion or erosion, and many other types. Steel and other metallic materials may be damaged by corrosion, fatigue, mechanical overloading, stress-assisted corrosion and embrittlement. Polymeric materials may be damaged during service by exposure to harsh conditions such as thermal cycling, moisture, and degradation by ultra-violet radiation. These forms of deterioration have become more and more prevalent as USACE infrastructure surpasses its originally designed service life. New tools and techniques for forensic investigations are needed to identify forms of deterioration and the cause of failures. These forensic investigations provide insights into fundamental deterioration and failure mechanisms that guide the development of repair and retrofit strategies for infrastructure.

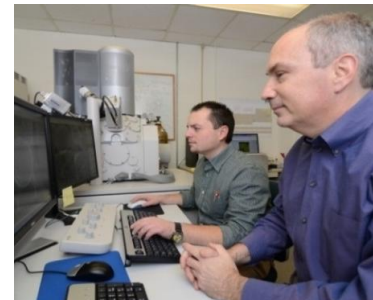


## Approach

The U.S. Army ERDC employed a tiered approach to forensic investigations of infrastructure deterioration and failure. Initial testing consisted of rapid screening studies to identify mechanisms of interest and define applicable investigation techniques. Based on these rapid studies, more in-depth characterization and testing was performed to provide more definitive answers. For concrete, investigations included various forms of microscopy (e.g., optical and scanning electron microscopy), chemical analysis, mineralogical analysis, durability testing (e.g., chloride ion concentration), and other techniques. For metallic materials such as steel and aluminum, various microscopy and metallographic techniques along with chemical analysis and mechanical testing were used. For polymeric materials (e.g., waterstops, joint sealants, coatings), various types of characterization, durability studies, and mechanical testing can be performed. Non-destructive testing and evaluation is another important component of this capability. The use of robust testing protocols executed by experienced engineers and scientists aids in providing customers with definitive answers that guide mitigation, repair, and retrofit efforts.

## Products

Unique capabilities to rapidly perform forensic investigations of infrastructure deterioration in support of USACE Districts have been developed. Reports have been provided to customers in a timely fashion that provide evidence and conclusions from forensic investigations and provide necessary inputs for repair and retrofit.



## Benefits

This in-house capability is being maintained and expanded to aid USACE Districts in investigations of infrastructure. The results provide the necessary inputs in order to effectively mitigate deterioration issues and also repair infrastructure to extend service lives.

**POC:** Dr. Robert D. Moser  
Charles E. "Eddie" Wiggins

[Robert.D.Moser@usace.army.mil](mailto:Robert.D.Moser@usace.army.mil)  
[Charles.E.Wiggins@usace.army.mil](mailto:Charles.E.Wiggins@usace.army.mil)